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NOTE ON THE MORPHOLOGY OF FULGUR.

BY BURNETT SMITH.

On the whole the marine gastropods are singularly free from individual abnormalities or deformations, and this rule holds good for the two large conchs (*Fulgur carica* Gmelin and *F. canaliculatum* Say) which are washed upon our Atlantic Coast in such large numbers during the winter storms. As far as the writer knows there is no record of an abnormal individual of *F. carica*. *F. canaliculatum*, on the other hand, has furnished a small number of deformed specimens which have found their way into museums. Some of these have been described and figured.

Deformations of the Shell in F. canaliculatum.—In the museum of the Academy of Natural Sciences of Philadelphia there are two abnormal shells of this species. In the first of these the branchial siphon has grown in such a way that its direction is almost at right angles to the axis of coiling of the spire. From an examination of the exterior of the shell it is impossible to state with certainty the causes of this condition. Whether it is the result of accident or of some truly pathologic condition cannot be determined.[1] The second specimen, collected at Longport, New Jersey, was figured and described by the present writer.[2] In this case the deformation can be traced to a break in the shell which occurred at a relatively early stage in the ontogeny. The result of this has been a complete change in the whorl form and sculpture, the tubercles and shoulder keel disappear and we have a smooth, rounded whorl very similar to that of *F. pyrum* Dilw. In this connection it is interesting to note that paleontological data points to the descent of *F. pyrum* either from *F. canaliculatum* or from some very closely allied form, and furthermore that this descent was marked by the almost complete disappearance (through acceleration) of the shoulder keel and the assumption of a smooth, rounded whorl outline. In other words we have here a striking parallel of an evolutional process which has taken place slowly during geological time and resulted in the change of one species into another, with a change which has been caused by accident in the growth of an individual.

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[1] "A Remarkable Monstrosity of Fulgur canaliculatum," C. W. Johnson and H. A. Pilsbry, *The Nautilus*, July, 1895, p. 25, fig. 1.

[2] Proc. Acad. Nat. Sci. Phila., June, 1902, p. 507, and April, 1905, p. 358, Pl. XXXI, fig. 10.

In this Longport specimen the animal when washed ashore fortunately possessed the soft parts intact. A carefull examination of these disclosed no unusual condition other than the fact that the mantle was rounded instead of angulated. The mantle edge was in no way peculiar and the penis, which in the normal male underlies the shoulder angle, was fully developed and exactly similar to that found in other individuals. In fact no peculiarity of the soft parts could be detected which would account for the causes of the change in shell growth.

Abnormality in the Soft Parts of F. canaliculatum.—In the specimen just described the absence of a shoulder angle in the mantle and in the shell does not seem to be connected in any way with the underlying reproductive organ. Fig. 1 shows the character of the normal, backward folded penis which lies immediately below the shoulder angle. Inasmuch, then, as we have noted an individual with abnormal shell but with normal reproductive organs, it is of interest to call attention to another specimen collected by the writer which has an entirely normal shell but whose reproductive organs are imperfect (fig. 2). In this case the penis is small, not being more than one-fifth the usual length. If this condition had been the result of an injury to the penis we might expect to find traces of its original condition at least around its base. This, however, is not shown for the base is small, having about one-half the normal width. We are therefore justified, it is believed, in regarding this as an instance of arrested development in a particular organ. No other abnormalities in the soft parts were observed and, as stated before, the shell is in every regard similar to that of the normal individual.

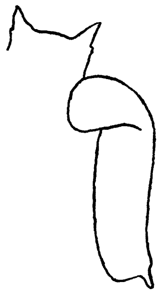

Fig. 1—*Fulgur canaliculatum* Say. Diagram showing the normal male reproductive organ.

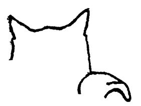

Fig. 2—*Fulgur canaliculatum* Say. Diagram showing undeveloped male reproductive organ.

The Penis of F. carica.—Some interesting points in the comparative morphology of *F. canaliculatum* and *F. carica* are furnished by a study of the male reproductive organ. In the former species the penis is turned backward and folded (fig. 1). It likewise retains the same width at the distal end as at the proximal, while in addition the terminal process is relatively large. In *F. carica,* on the other hand, the organ tapers gradually from the proximal to the distal end and the terminal process is very small (fig. 3). The penis though turned backward is not folded at the turn as in *F. canaliculatum.*

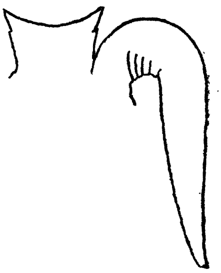

Fig. 3—*Fulgur carica* Gmelin. Diagram showing the normal male reproductive organ.

Influence of the Soft Parts on Shell Form and Sculpture.—No one, of course, denies that all the features of the gastropod shell, its form, size and ornamentation, are the result of changes in the lime-secreting soft parts. A shoulder keel, for instance, is caused by a permanent angle, while a spine represents the effect of a temporary elevation of the mantle. What is it though which produces this temporary bulging of the mantle edge? What is the physiological meaning of the spine? This is a question which has never yet been satisfactorily answered in spite of many ingenious suggestions. One view, often expressed, holds that the spines represent an activity of the mantle edge which is manifested at recurrent reproductive periods. This may indeed be true, but it is yet to be proved.

To apply the discussion to the forms considered in this paper we may ask: Have the spines in *Fulgur carica* any connection with either copulation or oviposition? Though this question could probably be solved at one of our marine laboratories, its solution has apparently never been attempted. In the absence, then, of definite information on the subject, it is believed that it is pertinent to outline here certain objections which might be raised against the above theory.

(1) If the spines are caused by oviposition there is a difficulty in explaining their equal development in both the male and the female.

(2) If the spines are caused by the act of copulation there is likewise a difficulty in explaining their exact similarity in the two sexes.

To extend our inquiry to *Fulgur canaliculatum,* it is first to be noted that this species has no true spines. In this form the spines have disappeared, their former presence being shown by the small tubercles which have been crowded back by acceleration into the early whorls.

It is difficult therefore to believe that spine production in *Fulgur* is the result of reproductive activity when we regard these two Atlantic Coast species, with equally well developed reproductive organs and with presumably similar habits of oviposition, the one spineless and the other spined. By an examination of the penis in the two species we can select no character in one which should produce a spine, or in the other case state why the protrusion of the penis should not produce a spine.

Considering now the shoulder keel, which seems to be the evolutional successor of the row of spines, we know by actual observation that the non-development of the penis in *F. canaliculatum* does not necessarily affect the keel, while, on the other hand, an injured keelless individual may possess the organ in its normal condition.

From these facts we can be reasonably confident that the shoulder keel has no connection with reproductive activity. When it comes to the spines, however, we can but say that there are no characters in the penis of *F. canaliculatum* which we can definitely correlate with the spineless condition of the shell, and in *F. carica* we can assign to the different form of the organ no cause for the development of spines.